Claims

[c1]   1.A macroblock-counting error-detector comprising:

a macroblock decoder, coupled to a bitstream input, for decoding macroblocks in a bitstream;

a macroblock counter for counting a number of macroblocks decoded from the bitstream;

a header decoder, coupled to the bitstream input, for decoding a packet header that includes a header macroblock number;

a count comparator, coupled to the macroblock counter and to the header decoder, for comparing the header macroblock number to a macroblock count from the macroblock counter;

an error controller, activated by the count comparator, for controlling over-writing of the macroblock counter by the header macroblock number to recover from a macroblock counting error;

a discontinuity calculator, responsive to the error controller, receiving edge pixels from at least two macroblocks, the edge pixels being along at least one common edge between the at least two macroblocks, for calculating a degree of pixel discontinuity; and

a discontinuity comparator for comparing the degree of pixel discontinuity from the discontinuity calculator to a threshold, the error controller over-writing the macroblock counter with the header macroblock number when the threshold is met,

whereby the degree of pixel discontinuity controls over-writing of the macroblock counter with the header macroblock number.

[c2]   2.The macroblock-counting error-detector of claim 1 wherein the header macroblock number indicates a first macroblock in a next video packet after a packet containing the macroblocks having the edge pixels,

whereby the degree of pixel discontinuity is calculated for macroblocks in a previous packet before the header macroblock number.

[c3]   3.The macroblock-counting error-detector of claim 2 further comprising:

a start-code detector, coupled to the bitstream input, for detecting a start code at a beginning of a new frame;

wherein the macroblock counter is initialized when the start code for the new
frame is decoded from the bitstream,

whereby the macroblock counter is initialized for each new frame.

[c4]   4.The macroblock-counting error-detector of claim 3 further comprising:

a resync detector, coupled to the bitstream input, for detecting a resync marker
at a beginning of a video packet, the resync detector activating the header
decoder when the resync marker is detected.

[c5]   5.The macroblock-counting error-detector of claim 4 wherein the discontinuity
calculator generates a sum-of-the-absolute difference (SAD) of pixels along
macroblock boundaries.

[c6]   6.The macroblock-counting error-detector of claim 5 wherein the discontinuity
calculator generates a maximum SAD for all macroblocks in a video packet, the
maximum SAD being the degree of pixel discontinuity.

[c7]   7.The macroblock-counting error-detector of claim 6 wherein the error
controller over-writes the macroblock counter with the header macroblock
number when the macroblock decoder detects a decoding error in a previous
video packet.

[c8]

8.A method for detecting a macroblock sequencing error comprising:

decoding a packet header that follows a resync marker for a new video packet in
a frame;

comparing a header macroblock number read from the packet header to a
macroblock count;

when the header macroblock number matches the macroblock count, decoding
macroblocks in the new video packet and incrementing the macroblock count
for each macroblock decoded;

when the header macroblock number does not match the macroblock count,
and when an error was detected in a previous packet, updating the macroblock
count with the header macroblock number and decoding macroblocks in the
new video packet and incrementing an updated macroblock count for each
macroblock decoded;

when the header macroblock number does not match the macroblock count, and when no error was detected in a previous packet:

calculating a pixel difference between adjoining macroblocks in the previous packet;

comparing the pixel difference to a threshold;

when the pixel difference exceeds the threshold, updating the macroblock count with the header macroblock number and decoding macroblocks in the new video packet and incrementing the updated macroblock count for each macroblock decoded; and

when the pixel difference does not exceed the threshold, not updating the macroblock count, decoding macroblocks in the new video packet and incrementing the macroblock count for each macroblock decoded,

whereby the header macroblock number updates the macroblock count when the pixel difference exceeds the threshold upon a mismatch with the macroblock count.

[c9]   9. The method of claim 8 wherein calculating the pixel difference comprises:

generating a pixel difference between a first pixel in a first macroblock and a second pixel in a second macroblock, the first and second pixels being adjacent to each other but in different macroblocks;

generating pixel differences for other first and second pixels along a boundary between the first and second macroblocks; and

summing the pixel differences to generate the pixel difference compared to the threshold,

whereby differences among pixels along macroblock boundaries are summed.

[c10]   10. The method of claim 9 further comprising:

determining a maximum pixel difference for macroblocks in the previous packet;

wherein comparing the pixel difference to a threshold comprises comparing the maximum pixel difference to the threshold,

whereby the maximum pixel difference is compared.

[c11]
11. The method of claim 10 further comprising:

obtaining an absolute value of the pixel differences before summing the pixel differences,

whereby the pixel difference compared is a sum-of-absolute difference (SAD).

[c12] 12.The method of claim 9 wherein generating pixel differences along the boundary between the first and second macroblocks comprises generating pixel differences along a left edge of the first macroblock;

further comprising:

generating an upper sum of upper pixel differences with a third macroblock above the first macroblock for an upper edge of the first macroblock;

adding the upper sum when summing pixel differences before comparison,

whereby pixel difference for left and upper edges of the first macroblock are summed.

[c13] 13.The method of claim 8 further comprising:

detecting an error when decoding macroblocks in the video packet;

concealing the error detected when decoding the macroblocks in the video packet,

whereby detected macroblock errors are concealed.

[c14]

14.An motion-picture-experts group (MPEG) decoder comprising:

a resync detector, coupled to receive a bitstream, for detecting a resync marker at a beginning of a video packet;

header means, activated by the resync detector, for decoding a video-packet header in the bitstream after the resync marker, the header means extracting a header macroblock number that identifies a location within a frame for a first macroblock after the video-packet header;

decoder means, coupled to receive macroblocks in the bitstream after the video-packet header, for decoding pixel data for each macroblock;

macroblock counter means, coupled to the decoder means, for counting a number of macroblocks in the frame, the macroblock counter means having a counter value;

header compare means, coupled to the macroblock counter means and to the header means, for signaling when the counter value mismatches the header

macroblock number;

boundary means, receiving edge pixels from two adjacent macroblocks, for calculating a pixel-difference measurement that indicates an image change across a boundary between the two adjacent macroblocks, the edge pixels being along the boundary;

threshold means, coupled to the boundary means, for determining when the pixel-difference measurements have met a threshold value for indicating a macroblock counting error; and

error means, coupled to the threshold means, for writing the header macroblock number from the header means to the macroblock counter means to update the counter value with the header macroblock number when the macroblock counting error is detected,

whereby macroblock counting errors are detected and the macroblock counter means updated to recover from the macroblock counting error.

[c15]   15.The MPEG decoder of claim 14 further comprising:
a pixel memory for storing pixels for macroblocks in the frame, the boundary means receiving edge pixels from the pixel memory.

[c16]   16.The MPEG decoder of claim 15 further comprising:
error conceal means, activated by the error means when the macroblock counting error is detected, for over-writing pixels in macroblocks in at least one of the two adjacent macroblocks to conceal the macroblock counting error.

[c17]   17.The MPEG decoder of claim 16 wherein the pixel data for each macroblock comprises a motion vector, an error term, or pixels in the macroblock.

[c18]   18.The MPEG decoder of claim 17 wherein the boundary means comprises a calculation means for generating a sum-of-the-absolute difference (SAD) of the edge pixels.

[c19]
           19.The MPEG decoder of claim 18 wherein the boundary means calculates the SAD for several macroblocks in a previous video packet;
wherein the boundary means further comprises maximum means for storing a maximum SAD for the several macroblocks in the previous video packet,

whereby the maximum SAD is compared to the threshold value.

[c20]   20.The MPEG decoder of claim 19 wherein the SAD is generated by combining an SAD for a horizontal edge and an SAD for a vertical edge of each macroblock.